Department of Pesticide Regulation

Paul E. Helliker
Director

Gray Davis
Governor

Winston H. Hickox
Secretary, California Environmental Protection Agency

M E M O R A N D U M

TO: Joseph Frank, Senior Toxicologist **HSM-02016**
Worker Health and Safety Branch

FROM: Sally Powell, Senior Environmental Research Scientist **[original signed by S. Powell]**
Worker Health and Safety Branch
(916) 445-4248

DATE: June 21, 2002

SUBJECT: EXPOSURES TO METHYL BROMIDE IN KERN COUNTY BASED ON THE SUMMER 2001 MONITORING BY THE CALIFORNIA AIR RESOURCES BOARD

This memorandum gives inhalation exposures as average concentrations of methyl bromide in air for 24-hour, 1-week and 8-week averaging periods, based on monitoring done by the California Air Resources Board in Kern County between 30 June and 30 August 2001 (ARB, 2002).

Methods

Following the practice of the Worker Health and Safety (WHS) Branch, this memorandum reports arithmetic mean concentrations and tolerance limits estimated using lognormal methods. Lognormality is assumed for environmental contaminants in most cases. DPR's experience with many large environmental datasets has shown that they are usually well described by the lognormal distribution. In addition, WHS prefers to avoid the inconsistency of using different exposure statistics based on sample characteristics. WHS uses the arithmetic mean concentration because the concentration of interest for exposure assessment is the overall concentration in all of the air that a person could breathe during the averaging period. The arithmetic mean concentration is the best estimate of the average mass of residue per unit of environmental medium; it is equivalent to compositing all of the samples and measuring the concentration of the mixture (Parkhurst, 1998). This is true regardless of the shape of the underlying distribution.

No samples below the detection limit of 0.0018 ppbv (7.1 ng/m^3) were reported by ARB. Forty-six samples with flow-rate deviations greater than 25% were excluded from this analysis. Where there were two usable samples for the same day at a site, the arithmetic mean of the values was used. There were seven cases where a site had usable samples for only two days in a week, one where there was only one day, and one site had no usable data for the first monitoring week. The data were not adjusted for recovery (range 102 to 150 % in laboratory, 118 to 152 % in trip and 109 to 152 % in field spikes).

24-hr exposure

For each monitoring-site separately, the maximum observed and the 95% tolerance limit for 24-hr concentrations are given. The 95% tolerance limit is the concentration that, with given probability, will be exceeded in 5% of future samples (Hahn and Meeker, 1991). It is calculated using lognormal distribution methods:

$$95\%\ \text{tolerance limit} = \exp\{\text{arithmetic mean of log concentrations} + g_{(.90;\ .95;\ n)} * (\text{sd of logs})\}.$$

The multiplier g for 90% probability is tabled in Hahn and Meeker (1991).

1-week exposure

For each monitoring site separately, the maximum and the 95% tolerance limit for weekly mean concentrations are given. Each weekly mean is calculated as the arithmetic mean of the 24-hr samples taken at a site during the week (i.e., nonmonitoring days are ignored). The 95% tolerance limit for weekly mean concentrations is calculated using normal distribution methods:

$$95\%\ \text{tolerance limit} = \text{arithmetic mean of week means} + g_{(.90;\ .95;\ n)} * (\text{sd of week means}).$$

Normal methods are used in this case because sample means from any distribution tend to be normally distributed.

8-week exposure

For each monitoring-site separately, average exposure over the 8-week monitoring period is calculated as the arithmetic mean of the weekly means (calculated as above for 1-week exposure).

Results

Twenty-four-hour, 1-week and 8-week concentrations are presented in Table 1. Daily concentrations and intermediate calculations are shown in Table 2.

Table 1. Methyl bromide concentrations (ppbv) in Kern County, 30 June – 30 August, 2001, based on monitoring by the California Air Resources Board.

		Daily		1-week		8-week
Site [a]	N days	Maximum 24-hr	95% tolerance limit	Maximum weekly[b] mean	95% tolerance limit	Mean of weekly means
		ppbv				
ARB	32	0.31	0.47	0.19	0.27	0.12
ARV	25	0.22	0.26	0.13	0.18	0.08
CRS	32	25.34	25.03	10.04	13.13	2.78
MET	29	0.25	0.25	0.13	0.17	0.07
MVS	26	0.23	0.29	0.15	0.20	0.08
VSD	27	0.23	0.31	0.15	0.20	0.08

a Monitoring sites described in ARB (2002).
b Each weekly mean is the arithmetic mean of the daily concentrations (*n* ranged 1 - 4) in a calendar week.

Exposure appraisal

The average concentrations presented here are based on limited monitoring data and must be considered as having some degree of uncertainty. The representativeness of the six monitoring sites is unknown. Each site was monitored only 1 - 4 days per week for a relatively short (9-week) period. Weekend days were not monitored. It is unknown whether weekdays and weekends differ systematically in numbers of methyl bromide fumigations.

References

ARB. 2002. Ambient air monitoring for methyl bromide and 1,3-dichloropropene in Kern County - Summer 2001. Final report dated June 18, Project No. P-01-004. Sacramento, CA: Quality Management Branch, Monitoring and Laboratory Division, Air Resources Board, California Environmental Protection Agency.

Hahn, G.J., and Meeker, W.Q. 1991. *Statistical Intervals: A Guide for Practitioners*. New York, John Wiley & Sons, Inc.

Parkhurst, D.F. 1998. Arithmetic versus geometric means for environmental concentration data. *Environmental Science and Technology News.* Feb. 1.

cc: Tom Thongsinthusak
Lori Lim
Randy Segawa

Table 2. Daily concentrations and intermediate calculations for Kern County sites.

		ppbv						ln(ppbv)					
Date	**Week**	**ARB**	**ARV**	**CRS**	**MET**	**MVS**	**VSD**	**ARB**	**ARV**	**CRS**	**MET**	**MVS**	**VSD**
30-Jun-01	1	0.037	0.027	0.263				-3.297	-3.624	-1.336			
1-Jul-01	1	0.029		0.114	0.022	0.023		-3.529		-2.176	-3.806	-3.756	
2-Jul-01	1	0.314		0.070	0.021			-1.157		-2.657	-3.883		
	1 Average	0.127	0.027	0.149	0.021	0.023							
6-Jul-01	2	0.0258	0.0486	0.0614	0.0344			-3.657	-3.025	-2.790	-3.370		
7-Jul-01	2	0.0199	0.0205	0.0249	0.0221		0.0200	-3.916	-3.887	-3.692	-3.811		-3.910
8-Jul-01	2	0.0195	0.0211	0.0233	0.0216	0.0207	0.0211	-3.937	-3.856	-3.761	-3.834	-3.880	-3.857
	2 Average	0.022	0.030	0.037	0.026	0.021	0.021						
13-Jul-01	3	0.1516	0.1263	25.1235	0.0583		0.1327	-1.887	-2.069	3.224	-2.841		-2.020
14-Jul-01	3	0.0664		1.4582			0.0363	-2.713		0.377			-3.316
15-Jul-01	3	0.0425	0.0269	0.2113	0.0240	0.0289	0.0300	-3.158	-3.614	-1.554	-3.731	-3.545	-3.505
16-Jul-01	3	0.1531	0.0646		0.0379	0.1306	0.0436	-1.877	-2.739		-3.273	-2.036	-3.132
	3 Average	0.103	0.073	8.931	0.040	0.080	0.061						
21-Jul-01	4	0.1577	0.2147	1.2192	0.1522	0.1711	0.2282	-1.847	-1.538	0.198	-1.883	-1.766	-1.477
22-Jul-01	4	0.0428	0.0501	8.2095	0.0497	0.0433	0.0458	-3.151	-2.993	2.105	-3.001	-3.139	-3.083
23-Jul-01	4	0.1142		0.5331		0.0906	0.0621	-2.170		-0.629		-2.401	-2.779
24-Jul-01	4	0.0394	0.0350	0.3597	0.0288	0.0468	0.0394	-3.234	-3.352	-1.023	-3.547	-3.062	-3.235
	4 Average	0.089	0.100	2.580	0.077	0.088	0.094						
29-Jul-01	5	0.0505	0.0256	0.6588	0.0260	0.0277	0.0223	-2.985	-3.664	-0.417	-3.649	-3.586	-3.804
30-Jul-01	5	0.1057	0.0515	0.0743	0.0281	0.0398	0.0558	-2.247	-2.966	-2.599	-3.572	-3.225	-2.886
31-Jul-01	5	0.0381	0.0417	0.7056	0.0386	0.0367	0.0404	-3.268	-3.178	-0.349	-3.256	-3.305	-3.210
1-Aug-01	5	0.0669	0.0323	0.0564	0.0326	0.0390	0.0343	-2.705	-3.432	-2.876	-3.424	-3.245	-3.373
	5 Average	0.065	0.038	0.374	0.031	0.036	0.038						
6-Aug-01	6	0.2941	0.2189	25.3358	0.2455	0.2276	0.2137	-1.224	-1.519	3.232	-1.404	-1.480	-1.543
7-Aug-01	6	0.2270		4.3815	0.1157	0.1582		-1.483		1.477	-2.157	-1.844	
8-Aug-01	6	0.1173	0.0968	9.8433	0.0901		0.0949	-2.143	-2.335	2.287	-2.407		-2.355
9-Aug-01	6	0.1182	0.0556	0.5905	0.0602	0.0645	0.0621	-2.136	-2.889	-0.527	-2.810	-2.742	-2.778
	6 Average	0.189	0.124	10.038	0.128	0.150	0.124						

Continued

Table 2. Continued.

		ppbv						ln(ppbv)					
Date	**Week**	**ARB**	**ARV**	**CRS**	**MET**	**MVS**	**VSD**	**ARB**	**ARV**	**CRS**	**MET**	**MVS**	**VSD**
14-Aug-01	7	0.1781	0.1449	0.4644	0.1267	0.1630	0.1435	-1.725	-1.932	-0.767	-2.066	-1.814	-1.942
15-Aug-01	7	0.2387		0.9435	0.1651	0.1511	0.2331	-1.433		-0.058	-1.801	-1.890	-1.456
16-Aug-01	7	0.1508		0.6438	0.0670	0.1079	0.0972	-1.892		-0.440	-2.702	-2.226	-2.331
17-Aug-01	7		0.1180	0.6152	0.1330	0.1101	0.1128		-2.137	-0.486	-2.017	-2.206	-2.182
	7 Average	0.189	0.131	0.667	0.123	0.133	0.147						
22-Aug-01	8	0.1996	0.0985	5.7363	0.0725	0.0868	0.1043	-1.611	-2.318	1.747	-2.625	-2.444	-2.260
23-Aug-01	8	0.1331	0.1254	1.7730	0.1925	0.1147	0.1432	-2.017	-2.076	0.573	-1.647	-2.165	-1.943
24-Aug-01	8	0.0836	0.0538	0.1469	0.0361	0.0657	0.0552	-2.481	-2.922	-1.918	-3.322	-2.722	-2.897
25-Aug-01	8	0.0571	0.0611	0.1740	0.0475	0.0551	0.0660	-2.864	-2.795	-1.749	-3.047	-2.898	-2.719
	8 Average	0.118	0.085	1.958	0.087	0.081	0.092						
28-Aug-01	9	0.0793		0.0949		0.0726		-2.534		-2.355		-2.622	
29-Aug-01	9	0.3140	0.0778	0.7147	0.0774	0.1004	0.1213	-1.158	-2.554	-0.336	-2.559	-2.298	-2.110
30-Aug-01	9	0.0806	0.0765	0.1316	0.0576	0.0751	0.0722	-2.518	-2.571	-2.028	-2.855	-2.588	-2.628
	9 Average	0.158	0.077	0.314	0.067	0.083	0.097						
								Overall means					
Mean of week means		**0.118**	**0.076**	**2.783**	**0.067**	**0.077**	**0.084**	-2.44	-2.80	-0.67	-2.91	-2.65	-2.69
SD of week means		**0.056**	**0.039**	**3.905**	**0.040**	**0.045**	**0.042**	Overall stdevs					
								0.81	0.69	1.87	0.74	0.67	0.72
Max of week means		**0.189**	**0.131**	**10.038**	**0.128**	**0.150**	**0.147**						
n weeks		9	9	9	9	9	8						
95th %ile of week means		0.222	0.148	10.045	0.142	0.161	0.164						
90% tol limit on 95th% of week mns		**0.266**	**0.179**	**13.132**	**0.174**	**0.197**	**0.200**						
Max of days		**0.314**	**0.219**	**25.336**	**0.246**	**0.228**	**0.233**						
n days		32	25	32	29	26	27						
95th %ile of days		0.35	0.20	12.20	0.19	0.22	0.23						
90% tol limit on 95th%ile of days		**0.47**	**0.26**	**25.03**	**0.25**	**0.29**	**0.31**						